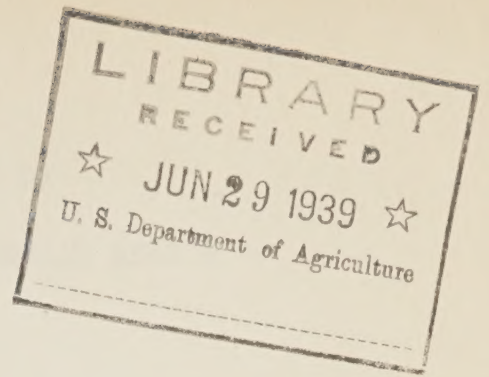


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INSTRUCTIONS FOR SURVEYS AND CONTROL OF
BARK BEETLE OUTBREAKS IN THE CENTRAL ROCKY MOUNTAIN REGION

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INSTRUCTIONS FOR SURVEYS AND CONTROL OF
BARK BEETLE OUTBREAKS IN THE CENTRAL ROCKY MOUNTAIN REGION

One of the most important problems in the protection of forests in the central Rocky Mountain region is the prompt detection and control of incipient forest-insect outbreaks. The administrative officer or forester in charge of a particular tract of forest land is charged, in addition to numerous other duties, with the responsibility of protecting the timber under his jurisdiction from undue losses caused by insects. The Division of Forest Insect Investigations is responsible for conducting research on forest insects and for furnishing technical assistance to land-managing agencies in matters pertaining to forest insects and their control. Because of the increasingly large number of bark beetle outbreaks occurring during the past few years and the more concentrated efforts to control them, there is a demand for information on the methods used in detecting and suppressing these epidemics. Since the Black Hills beetle is the number one enemy of pines in the central Rocky Mountain region and since the methods used to combat this insect are in general applicable to other bark beetles the following instructions deal primarily with that insect. In case additional information is desired, either on the Black Hills beetle or other forest insects, requests should be sent to the Bureau of Entomology and Plant Quarantine (Forest Insect Laboratory, 210 Forestry Building, Fort Collins, Colo.). Whenever possible host material showing the damage as well as insect specimens in good condition should accompany the request.

The first and most important step in any detection scheme is a thorough reconnaissance survey. If this survey reveals numerous red tops it should be followed by a thorough extensive survey which, if it reveals any epidemic conditions, is followed by control work. Control work can be divided into two equally important operations, (1) spotting and (2) treating. A detailed discussion is given below on how the two types of surveys and the control work should be carried out.

RECONNAISSANCE SURVEYS

Reconnaissance, red top, or high-point surveys are made to determine what areas are in need of a more detailed examination and what areas are free enough from insect damage to eliminate them from immediate further attention. These surveys are usually made between June 15 and September 14 in questionable areas or on forests where forest officers have reported evidence of an insect infestation. A more satisfactory method would undoubtedly include an annual reconnaissance of all susceptible timber types to locate aggressive infestations so that they can be controlled while still concentrated in small areas.

A reconnaissance survey is generally made by one man who should be thoroughly familiar with insect infestations and all phases of control work and capable of exercising considerable independent judgment in his work.

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Since this survey is largely based on the judgment of the estimator, it is advisable for the same man to make the examination year after year. Once familiar with an area the estimator can more readily determine the aggressiveness of an infestation.

The duties of an estimator on this type of survey are to locate and map areas in which beetles appear to be well enough established to form the nucleus of an epidemic, and to lay plans for an extensive survey of these areas. He should not attempt to estimate the number of trees likely to be infested during subsequent flight of the beetles. In making the plans for the extensive survey, the estimator decides upon the portion of the area to be covered in order to obtain a representative sample. Some areas may be encountered where an infestation has already reached such serious proportions that the necessity of control is very evident. Even in such cases it is probably advisable to conduct the extensive survey so that more reliable information can be obtained on the number of infested trees. This will not only result in better estimates of the cost of the project but will furnish a better basis for planning the control work.

The estimator should be equipped with binoculars, a topographic map of the area, pocket compass, tally register, small hand axe, notebook, and pencil.

Once in an area the estimator should take advantage of roads, look-out stations, and ridges, and in general see as much of the country as possible in a short period of time. The estimator should count and record all red tops visible, from as many vantage points as practical. The size of the groups should also be noted, since this information aids in determining the status of the infestation.

General observations may be very inaccurate unless they are checked at frequent intervals by sample strips or plots. From these representative samples the ratio between the number of trees actually occurring and those counted from the vantage points can be determined. Sample strips are usually the most satisfactory method and can often be obtained in going to and from vantage points. Since this survey is made after the greater portion of the infested trees have faded, a strip three or more chains in width can be efficiently covered. These strips should be run on a compass line and the distances accurately paced. All dying trees encountered on strip lines should be examined to determine, if possible, the cause of their death. During the first week in July it may be found that 30 percent or more of the infested trees still retain a healthy green color although these trees may be heavily infested. Therefore, when groups are encountered it is necessary to determine the ratio between infested green and infested faded trees. This is done so that a correction can be made to be added to the number of fading trees observed from vantage points.

On the basis of the number and type of infested trees, the estimator determines the status of the infestation after making proper allowance for blind spots due to topography, for trees dying from causes other than bark

beetles, and for infested trees which have not faded sufficiently to be seen from a distance. In many cases it may be found that only one-fourth or one-fifth of the infested trees are being counted from the vantage points.

When the reconnaissance of a forest has been completed the estimator should know the location and general trend of the infestation on areas where the insect occurs, and where additional surveys are advisable. He should also know what areas are free from infestation and require no further immediate surveys. He should have enough information to be able to plan carefully the extensive survey, making such recommendations as location of camps, percent of area to be sampled, and approximate number of man-days necessary to make the survey.

EXTENSIVE SURVEY

The object of an extensive survey is to obtain an estimate of the number of infested trees that require treating, to map areas where control measures should be carried out, and to eliminate areas that do not warrant treating. They usually follow the reconnaissance survey on which they are based, but furnish much more detailed information than the reconnaissance.

This survey can be begun about the first of September and should be completed as soon as possible after this date so that plans can be made for fall control work. However, should circumstances warrant, this survey can be made any time up to the first of July.

It is very important that these surveys represent a large enough sample of the areas under consideration to give reliable results. The percentage of the area necessary for an adequate sample will vary greatly with the size of the area, uniformity of the infestation, timber type, and topography. In large, uniformly infested areas of ponderosa pine he may find that a 2-1/2 percent survey will be sufficient for accurate results, or even a 1 1/4 percent survey in extensive lodgepole pine stands; while in small areas, or sections where several factors appear to be responsible for the death of the trees, it may be necessary to make a 10 percent survey in order to obtain reliable information. If a reconnaissance survey has been made of the area, extensive survey recommendations should accompany the reconnaissance report. If no reconnaissance has been made it is usually necessary for the chief of party to spend a few days sizing up the area before definite plans can be made.

The sample-strip method is probably the most satisfactory method of obtaining reliable information. Sample strips should be run in a direction perpendicular or quartering to the direction of the drainage whenever practical and should not follow ridges or streams.

The crew should consist of from three to five men each working independently. The foreman should plan the work and be responsible for all work in addition to running his strip.

A general compass bearing is run with the distances traveled being paced. The cruiser should take advantage of long fore sights whenever possible. Once he has chosen his course he should adhere to it as closely as possible and not veer from his strip in order to go through groups of infested timber.

The cruiser should check his pacing against measured distances on various slopes before he starts the work, and it is advisable to continue this checking at intervals throughout the survey. While pacing, the cruiser should record his double paces on a tally register. This operation soon becomes automatic and the cruiser can give full time to the timber through which he is passing. A strip one chain (66 feet) in width is recommended, since this enables the cruiser to examine trees on his strip with a minimum of side travel.

New attacks occurring on the strip are blazed and recorded under the column headed "N.A." (chart 1). Care should be taken to record only infested trees occurring within the strip. The distance paced to the "N.A." is recorded under the column headed "chains." The cruiser should start his pacing from zero with each change of bearing. General information such as new attacks occurring off strip, groups of "red tops," old fields, rivers, main roads, and other information that will help to make a clear picture of the area should be recorded under the column headed "remarks." An accurate "red top" count need not be made. The number of trees in "red top" groups should be estimated, but these trees need not be closely examined.

When impassable objects such as lakes, cliffs, etc., are encountered on a strip line, it is necessary to make an offset at right angles to the strip. When an offset is more than 5 chains it should be recorded as a change of bearing. When nonsusceptible areas, such as aspen, reproduction, and open parks, are encountered it is advisable to record them when the distance across such areas exceeds 5 chains. When a cruiser reaches the end of his strip an offset of 40 chains on a $2\frac{1}{2}$ percent survey, or of 20 chains on a 5 percent survey, etc., is made and the return strip run parallel to the first strip.

A large-scale map of the area can be used as a progress map. At the end of each day each cruiser should plot his strip on the map as accurately as possible. The number of "N.A." and their location should be plotted along the strip line. The number of the sheet used in keeping field notes should be indicated in a circle at the beginning of each strip plotted on the map. Each cruiser should draw his strips on the progress map using the particular color previously assigned to him. This enables the man in charge to readily determine what areas have been covered and by whom.

Notes should be kept on the attached form (chart 1), care being taken to fill out the heading in full. Each cruiser starts with sheet No. 1 and numbers his sheets consecutively until the unit is completed. The number of chains traveled and the number of "N.A." found are totaled at the end of each day by each cruiser.

A weekly progress report, showing miles of strip line cruised, number of "N.A." found on strip, number of man-days spent, and camp location, should be sent to the officer in charge at the close of each week.

The equipment necessary for each cruiser is as follows:

- 1 box compass
- 1 tally register
- 1 one-half-letter-size tatum holder
- 1 hand axe
- 1 colored pencil
- Pencils and forms (E.Q.-104)

When the extensive survey has been completed on a unit the chief of party should prepare a general statement of conditions of the infestation and features of the area. This should include type of topography, timber type, age and condition of stand, accessibility, etc., as well as character of attacks, aggressiveness of infestation, remarks on grouping, or other information which will help to make clear the conditions on the unit. This statement with the field notes and progress map should be turned over to the officer in charge when the unit is completed.

CONTROL

Spotting.--Spotting is the first and most important job in a control operation. It consists of a 100-percent cruise of epidemic areas, and can be done any time between September 15 and July 1. All infested trees are marked and mapped accurately enough to enable treating crews to locate them with a minimum loss of time.

The size of the spotting crew varies with the timber type and topography. A three-man crew can efficiently carry on spotting work in open pine stands on a level terrain. A five-man crew consisting of a compassman and four spotters is probably the most efficient in a mountainous country and in areas where a mixed timber type exists.

The compassman keeps the records (chart 2) and maps (chart 3) and is responsible for the work done by the crew. Where the infestation is light the compassman may find that less time will be lost if he has one of the spotters keep the spotting record in addition to running his strip. The crew should be well trained before actual spotting is started. If one or more members of the crew have not had spotting experience, someone thoroughly familiar with the work should spend 2 days training the crew in the field before spotting is actually started.

Infested trees may ordinarily be recognized by small masses of pitch (pitch tubes) which exude from the hole made by the beetle entering the tree. Upon closer examination it will be found that heavily infested trees usually have many small reddish tubes with boring dust mixed with the pitch. Very heavily attacked trees may have very few or no visible pitch tubes. These

trees can be identified by boring dust on the bark and at the base of the tree. Upon cutting through the bark, the presence of blue stain on the wood is a sure indication that the tree contains bark beetle brood. Woodpecker work in green trees indicates that insects are present. Large white pitch tubes indicate an unsuccessful attack and generally occur on trees which have had a sufficient pitch flow to overcome the attack. By hacking through the bark above such tubes it will usually be found that the egg galleries are short and pitched over and frequently contain one or two dead adult beetles. Trees with attacks of this type only should not be marked. The spotters should not chop into trees unless it is necessary to do so in order to determine whether or not the tree is infested. An experienced spotter will not have to make more than one or two small hacks on a tree in question to determine whether or not it is a "bug" tree.

The first job of a spotting crew is to establish a base line or lines from which all trees are located. Base lines should follow roads or trails that will be easily accessible to the treating crews. They are run with compass and chain as a traverse with stations marked every 10 chains of cardinal direction (chart 4). The stations should be marked with a piece of flagging and a bark blaze on the side facing away from the trail or road, marked with black lumber crayon as follows:

Sta. 1	(2, 3, etc.)
I. C.	(Insect Control)
39	(1939)

When the crew is ready to start spotting the compassman starts at a station and paces the distance on a general compass bearing perpendicular to the cardinal direction of the base line. The compassman should not look for infested trees, but should map the country covered by indicating infested trees, streams, ridges, trails, rock outcrops, fences, and other objects that will enable the treating crews to locate more readily the infested trees. For this work a map drawn to the scale of 8 inches to the mile is preferable. At each 10-chain point on the strip line the compassman makes a bark blaze on a tree or writes on some object, with lumber crayon,

S-9	(Station from which the compassman started)
40	(40 chains from base line)

A small piece of flagging placed nearby aids in finding the information. At the end of the strip the compassman turns and retraces his steps, the spotters taking their respective places on the opposite side of the compassman, and the return trip is made. By retracing his steps the compassman will have more time to map in objects and will have an opportunity to check his pacing at every 10-chain point. In a very rough country he may find considerable variation in pacing up and down steep slopes.

Each spotter covers a $1\frac{1}{2}$ chain strip to one side of the compassman. The crew travels in echelon formation, each one guiding on the man ahead of him. It is important that the spotters keep this formation as nearly as

possible. Each spotter is responsible for finding, marking, and numbering infested trees occurring on his strip. When a spotter finds an infested tree he calls "bugs" and the entire crew stops. He then calls the approximate number of trees to be marked. If there are more than three trees the other spotters assist in marking them. Upon encountering a fence, mine shaft, or other prominent object, he should call out such information to the compassman, who will include it on the map.

The infested tree is blazed at head height and the compassman calls the number to be placed on it. The spotter repeats the number and gives the approximate diameter of the tree. The spotter then writes the number given and his initials on the blaze with lumber crayon. Single trees should have additional blazes placed on three or more sides. Groups of two or three trees need be blazed on two sides only, while larger groups may be blazed on one side only. When infested trees occur as singles or doubles, the spotters should note the severity of the attack. If the tree is only lightly hit, or the beetles are confined to one side of the tree or for other reasons the spotter does not think the tree will produce many beetles the following summer, he should tell the compassman that the tree is a questionable "bug" tree. If these questionable trees are isolated, or if for other reasons considerable expense may be involved in treating them it may be advisable for the treating crew to leave such trees untreated. When all trees of a group have been marked, the spotters should check on the numbers and look for trees which might have been missed. When it is certain that all infested trees in the group have been properly marked the spotters return to their former positions and continue on the strip.

The following equipment is necessary for a five-man spotting crew:

- 1 hand compass
- 1 surveyor's chain tape
- 2 tally registers
- 4 2# axes
- 1 hand axe
- 2 tatum holders (1/2 lettersize)
- Lumber crayons 365 $\frac{1}{2}$ Dixon
- Spotting record forms (chart No. 5)
- Pencils
- 1 large map of area
- Red flagging

Maps drawn in the field should be drawn to a scale of 8 inches to the mile. The spotting record kept in the field should indicate the number and the diameter of all trees marked. A large progress map should be kept in the spotting camp and should show the base line, the stations, the area covered, and the number of trees found on each 10-chain strip. The spotting maps and records are turned over to the treating crews, who use the maps to locate the infested trees and finish filling out the spotting records.

A weekly progress report to be filled out at the end of each week by the spotting foreman is an aid in supervising the work. Forms for this report are usually furnished by the officer in charge. These forms usually include the number of trees spotted, number of acres covered, cost per tree for spotting, number of infested trees per acre, and other information.

Treating.--Treating can be started about the 15th of September and should be completed by the 1st of July. Infested trees are located by the use of maps previously prepared by the spotting crews. The control foreman should do this work himself or appoint one or more men (scouts) to locate the infested trees ahead of the treating crews. When a scout has located one or more groups of "bug" trees he should return to the treating crew and assist them until the crew is ready to move. The scout can then lead the treating crew directly to the infested trees he has previously located. When a scout or member of a treating crew finds an infested tree that has not been marked by the spotters, he should report it to the foreman in charge, who is responsible for marking and mapping all trees missed by the spotters.

The first step in treating an infested tree is to peel the bark from the base of the tree or the stump portion including the undercut. The stump should be peeled all the way to the ground, care being exercised to remove the bark without removing chips of wood with it. This procedure does not result in leaving large chips of wood with the bark attached under which the brood can mature. In felling the trees, stumps should be cut as low as practical. Two-man felling crews are usually the most efficient. One or both members of the felling crew should call "timber" when a tree is about to fall.

After falling, the tree should be lopped to the tip. Infested limbs larger than 3 inches in diameter should have the smaller branches removed and placed in a pile. Noninfested branches, and infested branches less than 3 inches in diameter, can be scattered. The infested portion of the tree should be bucked into even log lengths, short enough to be handled by the crew. The tree should be examined every few feet to determine the upper margin of the attack, and the tree need not be bucked into log lengths or treated above the insect galleries.

Burning is the cheapest method of control and should be used whenever enough snow or moisture is present so that it can be done without danger of spreading fire. Considerable caution must be exercised in burning, as fire is a very dangerous tool. In order to assure a complete kill of the insects beneath the bark, all bark should be burned from the infested logs. When small patches of bark are not burned, it is often easier to peel the unburned portions than to reburn the log.

The building of decks is very important in obtaining efficient control. Decks should be built in clearings sufficiently large to prevent scorching of nearby trees. The infested logs should be placed on a bed of dry wood supported on each end by a dry log not exceeding 8 inches in diameter. The largest logs should be placed in the center of the deck where

they will receive the most heat. Infested logs should be spaced with dry wood that extends about 6 inches beyond the end of the infested logs in the deck. Care should be taken to cut the logs in even lengths, as logs extending beyond the other decked logs will be difficult to burn near the ends. It is well to have the largest amount of dry wood on the down-hill side where the fire is usually kindled, since the logs have a tendency to burn more rapidly on the uphill side. The infested limbs can be placed on top of the deck. When a deck is completed it should contain sufficient dry wood to burn all bark from the logs with the necessity of very little further work. The deck should be given a number and indicated on the map. After the treating is completed, the foreman in charge should inspect the work, and when it has been completed to his satisfaction he can blaze a charred log and write the date and his initials on the blaze with lumber crayon. Very large trees, or trees too large to be handled by the treating crew, can be burned, after felling and lopping, in one section by placing enough dry wood alongside and over the top to burn the bark from the infested portion.

Peeling the infested portion of the tree is a method which can be used to control the Black Hills beetle when the fire hazard is high or when for other reasons burning is objectionable. Felling and lopping should be done as indicated for burning. Trees to be peeled should be bucked into log lengths only when they are too large to be rolled over by the crew. Peeling can be done efficiently with peeling spuds. The bark should be removed without chipping wood with it. The operation should start at the butt and progress up the tree until there is no further sign of the insect. Only the portion of the tree harboring the insects need be treated.

Control foremen should finish filling out the spotting records, but trees cut and decked should not be counted as treated until burning is completed. These records should be turned over to the officer in charge at the end of the project. A weekly progress report should be prepared at the close of each week by the foreman in charge and sent to the officer in charge. This report should include the following information, not only for the week covered by the report but for the project to date: Number of trees treated, number of acres covered, number of man-days, cost per tree, cost per acre, and the number of trees left to be treated in the area if this figure is available.

The following equipment is necessary for treating:

- Maps and records prepared by spotters
- Axes
- Saws
- Wedges
- One-pound hammers
- Peeling spuds (when treating is done by the peeling method)
- Log carriers (may or may not be used)
- Lumber crayons

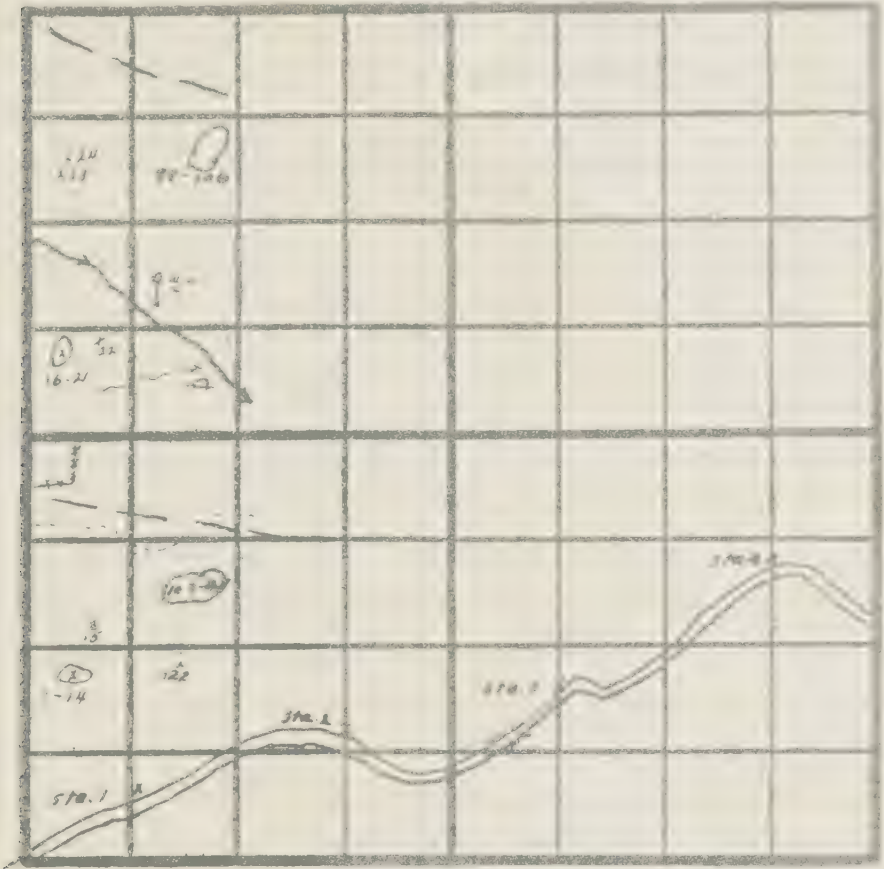
Chart 3

SECTION PLAT

Project area Deer Valley Unit

Date 10/20/38 T. 6S R. 72W Sec. 18

Compassman J. Jones 1/4 Sec. SW



Timbered acreage

Percentage by species

Volume B. F. per acre

Character of timber stand

Topography

General slope and exposure

Remarks:

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Chart 4

Distance to be subtracted from each chain run to
obtain cardinal distance traveled

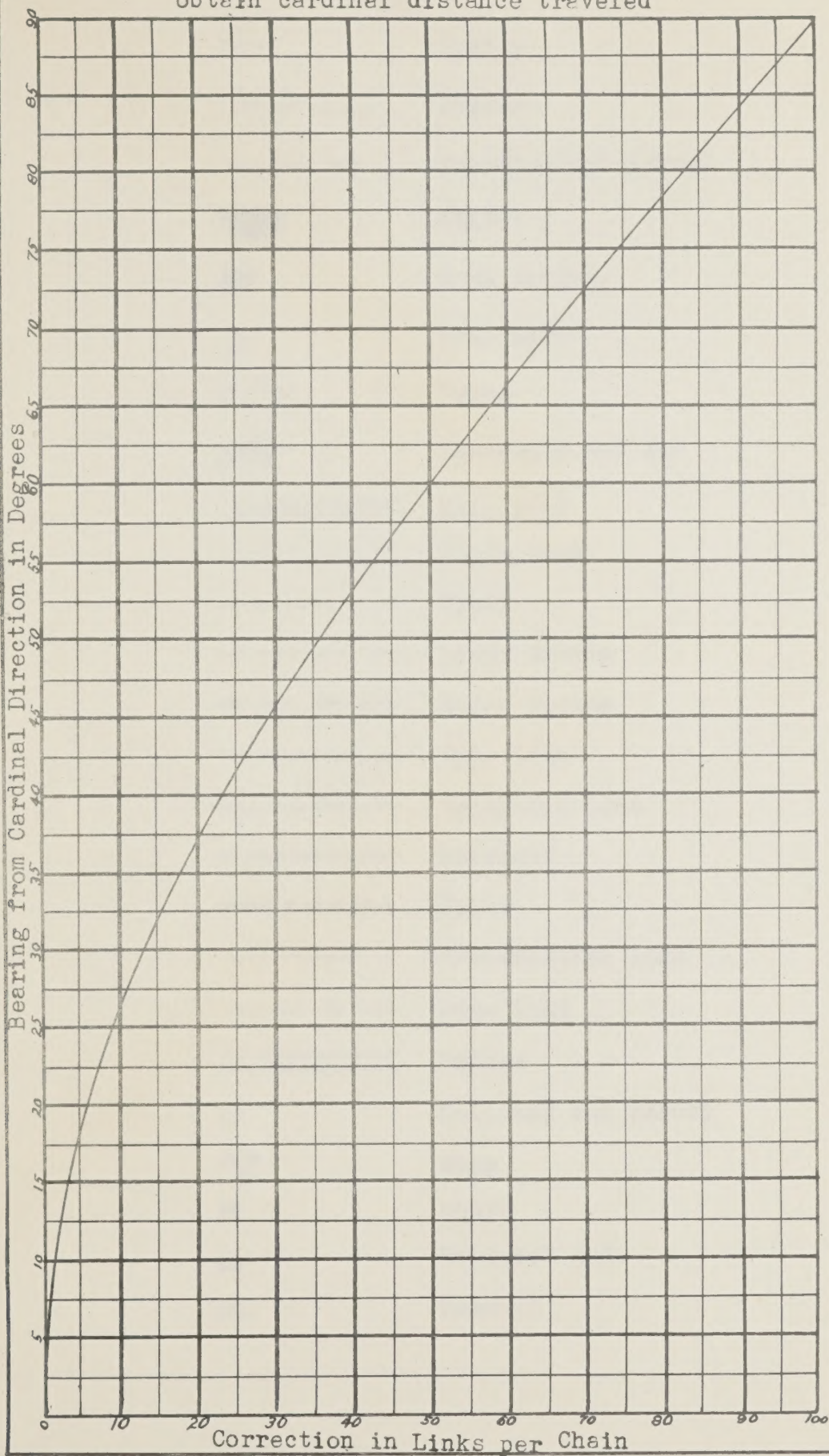


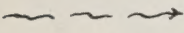





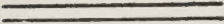
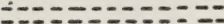
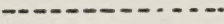

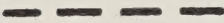


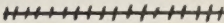

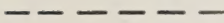

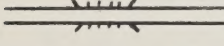







Table 1
List of the subjects (name and age) in
the medical history study

No.	Name	Age
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Continued in Table 2

MAP LEGEND

	Spring
	Stream
	Intermittent stream
	Cliff
	Rock outcrop
	High point
	Swamp
	Reservoir and dam
	Main road
	Minor road
	Trail
	Minor divide
	Major divide
	Type line
	Telephone line
	Railroad
	Fence
	Transmission line
	Pipe line
	Bridge
	Building and school
	Mine
	Shaft
	Prospect hole
	Sawmill

